MONALISA 2.0 AND THE SEA TRAFFIC MANAGEMENT - A CONCEPT CREATING THE NEED FOR NEW MARITIME INFORMATION STANDARDS AND SOFTWARE SOLUTIONS

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Abstract

This paper describes an innovative approach to integrate existing technology tools and instruments to implement a Sea Traffic Management system in Europe taking, as starting point, the successful TEN-T (Trans European Transport Network) co-funded project developed in the Baltic Sea and leaded by the Swedish Maritime Administration. The scope of MONALISA 2.0 project covers 10 EU countries and it is implemented by 39 entities representing public, private and academic sectors. Maritime Spatial Planning, Dynamic Route Planning, Route optimization, exchanging Information about Routes between ships and ships to shore, the possibility to have available a real time service for monitoring and coordinate sea traffic, are now a reality under the deployment of the different technologies applied. The improvement on ships performance and the response in case of accidents are other key elements introduced in MONALISA 2.0. This project will delivers new standards and protocols that will enable communicative machines in several levels, ship to ship, ship to shore and VTS to VTS, creating a comprehensive and interoperable network for a European Sea Traffic Management (STM) Service. STM is information sharing in the whole maritime transport chain. The industry of navigational system and aids, have agreed to support a new common standard making it possible to share route information between ships and from ship to shore. This is the first brick in building the holistic standard for the whole maritime transport chain. A new key contributor introduced is the unique identifier voyage number. Inspiration comes from the air industry (the SESAR project –but he flight numbers of today are NOT what we are going to implement!), where flight numbers + date make up a unique identifier that can be used for short and long term planning as well as for operational purposes. The partnership expects the transfer of STM information to happen in a System Wide Information Environment (SWIM). Maritime colleagues call this SWIM 'the maritime cloud'. We foresee modifications to all software involved in the transport chain, when new information streams will affect planning at all levels. This paper presents the first steps done to deploy the MONALISA concept and a new way for a safer, environmental and more effective maritime transport industry, and sending a clear message for any wrong understanding considering that MONALISA concept and STM will be the a new generation of tools where we will drive the ships from land: STM is not going to be a new ATM (Air Traffic Management) but at sea. The captain will always be in charge of both, the voyage plans decision and decisions in how to avoid collisions in dense traffic areas.

Keywords

VTS, AIS, Route Planning and Exchange, Sea Traffic Management, SAR

1. INTRODUCTION

Sea transport is the most effective mode to move large quantities of cargo over long distances. In terms of passengers, it is also the mode of transport that can move more amount of people by trip. Main waterborne routes are performed in oceans, coasts, seas, lakes, rivers and channels, being the north hemisphere countries the most developed in the maritime transport industry. In shipping, passengers and freight used to share the same vessels and often the same terminals. Since the 1950s specialization has occurred, and the two are now quite distinct, except for ferries and some RORO services, making possible to create new business models based on passengers, cargo, and both.

“Sea transport services are essential for the European economy to compete globally. In 2011, the Commission adopted a White Paper for Transport. It further specifies the orientations of the Maritime Transport Strategy until 2018: the ability to provide cost-efficient maritime transport services; the long-term competitiveness of the EU shipping sector; and the creation of seamless transport chains for passengers and cargo across transport modes. In 2011, the Commission proposed new guidelines for Trans-European Networks to broaden the role of the Motorways of the Sea as main European corridors. Through multi-annual calls, the Commission is leading the way in reducing the environmental impact of transport and in increasing transport efficiency” [1]. With this scenario in mind, sea and maritime safety is a key factor to maintain a sustainable maritime industry growth. The demand on new and competitive transport services and the multimodality approach require the interoperability among different modes of transport and interfaces like ports and corridors. “Since 2009, the EU and its Member States have been at the forefront in improving maritime safety. The aim is to eliminate substandard shipping, increase the protection of passengers and crews, prevent accidents and reduce the risk of environmental pollution. The implementation of the 2009 Third Maritime Safety Package improves the quality of European flags, the work undertaken by classification societies, the inspection of vessels in ports, traffic monitoring, accident investigation, and victim protection” [1].

In early 2010, Sweden and the Swedish Maritime Administration initiated a Motorways of the Sea project of wider benefit – MONALISA project (2010-EU-21109-S). MONALISA proceeds on the basis of the challenges facing the Baltic Sea region in the area of maritime transport, challenges that are outlined in the EU Strategy for the Baltic region. In 2013, MONALISA 2.0 takes its point of departure in the results and experiences from the former MONALISA project, co-financed by TEN-T under the Motorways of the Sea Programme.

As a MONALISA project extension in terms of geographical and technical innovations, MONALISA 2.0 will reuse the results and experiences from the development within the aviation sector and its SESAR (Single European sky Air Traffic Management Research) programme, which has been strongly supported by the European Union through the Framework Programmes and TEN-T during the past decade, to improve maritime safety in a common framework in Europe through the Sea Traffic Management (STM) concept. The objective is to make maritime transport safer, environmentally sustainable and more efficient in terms of life, time and money savings.

2. MONALISA PROJECT – THE ORIGIN

MONALISA aimed at making a concrete contribution to efficient, safe and environmentally friendly maritime transport. This has been done through the development, demonstration and dissemination of innovative **e-navigation** services to the shipping industry, which can lay the groundwork for future international deployment adopting improvements in standards.

Quality assurance of hydrographic data for the major navigational areas in Swedish and Finnish waters in the Baltic Sea is expected to contribute to improving the safety and optimization of shipping routes from the results obtained in the project.

MONALISA project was divided into four activities, all of which contribute to the achievement of objectives as follows: Dynamic and proactive route planning – "Green Routes"; Verification System for officer certification; Quality assurance of hydrographic data, and Global sharing of maritime information.

2.1. DYNAMIC AND PROACTIVE ROUTE PLANNING [2]

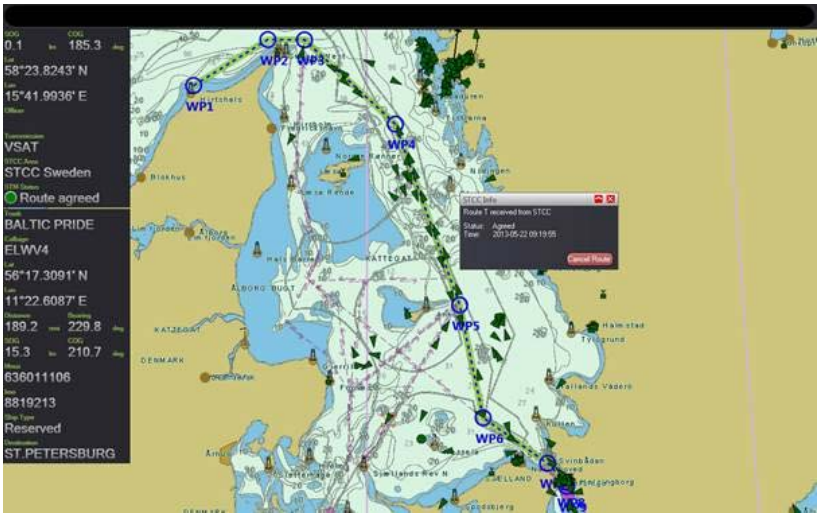
Some 80 000 ships passed in and out of the Baltic Sea during 2012, many of them tankers with dangerous cargo.

In order to strengthen the safety of shipping in the area, tests with dynamic and proactive route planning has been done within the first MONALISA project (test will be continued in the MONALISA 2 project until 2015, and will later be reported here).

The test bed includes a shore-based Ship Traffic Coordination Centre (STCC) and the ability of ship to exchange voyage plans from test bed ECDIS platforms (SAAB, and DMA's e-Navigation Prototype Display - in MONALISA 2.0, Transas will be involved).

The system is intended to be advisory and the process is as follows. A vessel approaching the MONALISA area will send its voyage plan to the STCC. STCC will validate it for under keel clearance and NoGo areas (and in MONALISA 2 also for separation to other ships). The voyage is then "agreed" by the captain and the ship is expected to follow its green corridor (except for obvious deviation due to traffic). Progress is then monitored from shore and route advice may be communicated to the ship. If there are any changes a new route request is made either from ship or from shore.

Figure 1 - A “green” agreed route between the shore traffic control and the vessel in the MONALISA system, here in the SAAB prototype platform.



source: MONALISA Project Reports

The intention is that the MONALISA functionality should be integrated in ordinary ECDIS systems based on a new standard and using the proprietary systems own functionality. Until that is possible prototype lab platforms has been used for testing.

2.2.VERIFICATION SYSTEM FOR OFFICER CERTIFICATION [3]

This activity involved the concept of an automatic system for, inter alia, monitoring and verifying certificates held by ships' officers. The envisaged model has been designed to have the capability to record officers' certificates and time spent on watch by each officer. A maritime ID-card with security codes has been designed and tested. With the use of automatic identification system (AIS) transmissions which is a technology already in place, the authenticity of ships' officers' certificates can be verified with shore-based information to determine whether the certificates are valid.

Figure 2. A pilot system of automated verification of ship crew certificates.

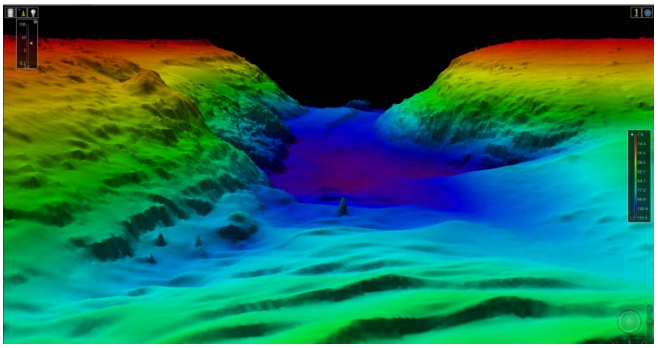
Source: MONALISA Project Reports

It is anticipated that such verification carried out automatically by the newly innovated system is expected to contribute towards ensuring seafarer competence and prevent, or at least minimize, work fatigue which is a crucial factor in the causation of casualties at sea arising from human error.

2.3. QUALITY ASSURANCE OF HYDROGRAPHIC DATA [3]

An important factor in safety of navigation is availability of adequate water depth for ships especially in enclosed and semi-enclosed seas and waterways. Water depth information is primarily available to the navigator through nautical charts which are constructed from hydrographic data. The discipline of hydrography involves information on water depth or bathymetry precisely co-related to geographical coordinates. Bathymetric data in turn is derived from hydrographic surveys mainly carried out by purpose-built hydrographic surface vessels or less commonly from airborne craft using laser beams known as Lidar bathymetric techniques. In the interests of navigational safety, quality assurance of hydrographic surveys and resulting data are urgently required. Such assurance of quality has become a pressing need due to the increasing number of deep draft vessels especially those navigating in relatively congested waters.

Figure 3 - Hydrographic survey using LIDAR techniques



sources: NOAA National Geophysical Data Centre and
Teledyne Odom Hydrographic

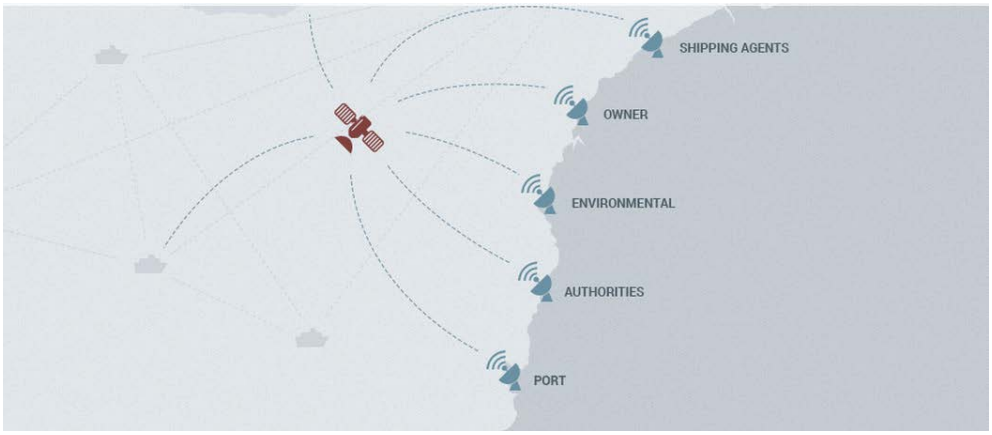
It is important, for example, to be aware of any previously unknown shoals possibly existing within the cracks of outdated sounding lines. Any such information will prompt the conduct of a re-survey expeditiously and urgently. It is necessary for re-survey of The Baltic Marine Environment Protection Commission (HELCOM) fairways and Baltic Sea port areas to be conducted without delay using modern quality-tested methods to ensure that hydrographic data presented in existing nautical charts and other nautical publications are correct and up to date. It was anticipated that the outcome of this activity shall form the basis for optimum route planning in MONALISA 2.0 project. Also, such matters as recommended fairways, dredging operations and other navigational decisions must be based on accurate hydrographic information obtained through rigorous scientific survey methods. The depiction of depth through appropriate

data models and vertical reference surfaces together with presentations of depths in nautical charts and publications are presently made in accordance with national standards [8]. This may pose obstacles for cooperation and exchange of bathymetric data. Thus, common technical standards have been elaborated within this activity to form a basis for decisions.

2.4. GLOBAL SHARING OF MARITIME INFORMATION

The aim of this activity has been to develop a functionally demonstrative system defined both technically and procedurally; the final objective being to extend the sharing of maritime information on to a global scale and also to expanding the scope of maritime information shared between maritime authorities which shall be consistent with their specific needs. It is contemplated that the activity must have been based on experiences gained from HELCOM AIS, Safe Sea Net and IALA Net. As a result, the extended application of Global Sharing of Maritime Information is one of the pillars to be reinforced within MONALISA 2.0 after the first tests under MONALISA project.

Figure 4 - The Maritime Information Exchange Scheme under the MONALISA concept



Source: MONALISA Project Webpage

3. MONALISA 2.0 – THE PRESENT AND A STEP FORWARD TO THE FUTURE OF MARITIME SAFETY

The Costa Concordia disaster gave impetus to the process of sharpening e-navigation generally; if a master changes course, as apparently occurred in that incident, the STCC must be informed, and in that case the STCC may have asked why the master was deviating from his passage plan. The ship sank after it capsized at Isola dei Giglio, Tuscany, on 13 January 2012 accident, 32 people died.

The South Korean ferry Sewol that sank off the South Korean coast on 15th April 2014, with the likely loss of more than 300 passengers, was being steered by an inexperienced

young officer who was navigating the area, which is notorious for its fast currents, for the first time.

The revelation lends weight to the theory that a series of errors by senior crew members caused the Sewol to list and capsize, prompting a major rescue operation and questions about safety measures as South Korea struggled to with one of the worst maritime disasters in its history.

The crew appeared underprepared to deal with a serious incident at sea amid reports that the vessel's owner, Chonghaejin, had not given them guidance in how to execute a swift evacuation. [4]

Figure 5 - The South Korean ferry Sewol sank
(left) and Costa Concordia Sank (Right)

source: Internet picture galleries

Both accidents recently happened demonstrate the existing gaps and fails in maritime transport safety, from the ordinary navigation watch keeping and navigational tasks, to the safety management after an accident occurs. Even the technology available is highly developed in terms of equipment, manning, communications, etc., its misuse, the lack in the decision making processes supported by proper risk assessment tools, the crisis management deficiencies from the ship side and the difficulties in coordinating the response actions between the Coast Guard services and the crew, reinforce the idea that something goes wrong. Human factor is still being the main incidents cause against the safer and more developed ships and equipment today.

More than three years after the Costa Concordia disaster, improving passenger ship safety continues to be a priority with a particular focus on services in Asia, where quality standards can be an issue. An increasingly difficult operating climate for ship operators has forced a number of innovations, including larger ship sizes to capitalize on economies of scale and the use of alternative fuels. Such scenarios present new risks and challenges, particularly around crew safety and training – it has been estimated that 80% of marine casualties are down to human error and lack of skilled workforce is still an issue. The claims arising out of maritime emergencies of “mega ships” can be huge, such as if an accident was to block entrance to a port. [5]

MONALISA 2.0 project takes the results from MONALISA project and is aimed to extend them in the way that several safety and operational aspects of the current Maritime Transport Industry may be improved dismissing or eliminating sever accidents like the mentioned above.

"MONALISA 2.0 will also make use of relevant results from earlier Motorways of the Sea projects, maritime R&D projects and re-use best practices from other areas in an effort to bring these further towards deployment in the maritime sector. The goal is that this will foster innovations and deployment of new technologies and systems to increase efficiency, safety, effectiveness and environmental sustainability of Motorways of the Sea and its integration in the Trans-European Transport Network. In MONALISA 2.0, the demonstrated results of Sea Traffic Management from MONALISA 2.0 will be taken a step further towards deployment through:

- testing of concrete applications and services which would allow rapid commercial deployment;
- integration of route planning tools with additional environmental information and maritime spatial planning for the purpose of improving maritime safety and environmental protection;
- joint private-public action to elaborate better standards for route information exchange through a common interface and common data format allowing equipment from all manufacturers be used for Sea Traffic management;
- demonstrating concrete/hands-on services using new technology to enhance maritime safety, making Search and Rescue and mass-evacuations more efficient than today and by addressing the urgent issue of safety in ports;
- re-using results of previous EU investments in Air Traffic Management as well as from other sectors and their application into the maritime domain." [6]

To reach these objectives, the MONALISA 2.0 project has been defined according four complementary activities that will be implemented until 31st December 2015. These activities are:

Act. 1 – Sea Traffic Management Operations and Tools
Act. 2 – Sea Traffic Management Definition Phase Study
Act. 3 – Safer Ships
Act. 4 – Operational Safety

3.1. SEA TRAFFIC MANAGEMENT OPERATIONS AND TOOLS

The aim of this activity is to verify and further develop operational and technical aspects that support the Sea Traffic Management concept of ship monitoring and coordination through, for example, route exchange between ships and shore centres, dynamic separation schemes and time slot allocation in congested waters.

This will be achieved through establishing a virtual Sea Traffic Coordination Centre (STCC) and engaging several European maritime simulator facilities that will be interconnected in macro simulations using a large number of simulated ships. Simulating an entire traffic environment in selected test areas makes it possible to study the effects on navigational behaviour, safety and efficiency, thereby identifying needs for further development before the STM concept becomes operational.

The concept will take a considerable leap forward towards deployment, as many of the manufacturers of navigational equipment have joined forces in MONALISA 2.0 in order to develop a route exchange format and architecture that allows route/voyage plan files to be seamlessly exchanged irrespective of the equipment brand.

A major share of maritime manufacturers are participating in the technical advisory group. Standard Operating Procedures will be further developed in order to foster safe and efficient deployment.

There are several Decision Support Tools available for route exchange and route optimization. In an effort to enhance concept efficiency, a number of Decision Support Tools will be integrated into the system.

A dynamic Maritime Spatial Planning tool will be integrated.

Different Applications and Services for STM will be tested and commercially validated.

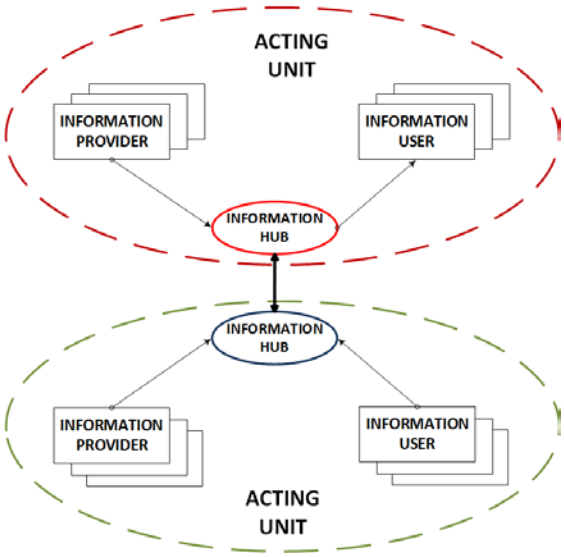
A Formal Safety Assessment (FSA) will be conducted.

Comprehensive conceptual tests and demonstration of STM from a navigational viewpoint will be carried out.

3.2. SEA TRAFFIC MANAGEMENT DEFINITION PHASE STUDY [7]

Development towards increased safety, sustainable environment, and higher profits within shipping cannot be enabled without Sea Traffic Management (STM). Reaching full effects of STM requires engagement from all actors operating within the maritime domain. Important enablers are increased degree of connectivity, increased possibilities of digital collaboration, seamless interoperability between systems, and highly distributed coordination (i.e. each actor taking responsibility for his/her own actions) in sea transportation. This concept represents an opportunity to move away from a traditional approach to Sea Traffic Management (the final goal for STM is to be self-sequential without central governance. Sea Traffic Management (2.0) will involve and engage multiple actors on multiple levels and will require new procedures for information sharing in a distributed manner within each engaged actor’s action scope.

Figure 6 - Distribution of information within and between acting units

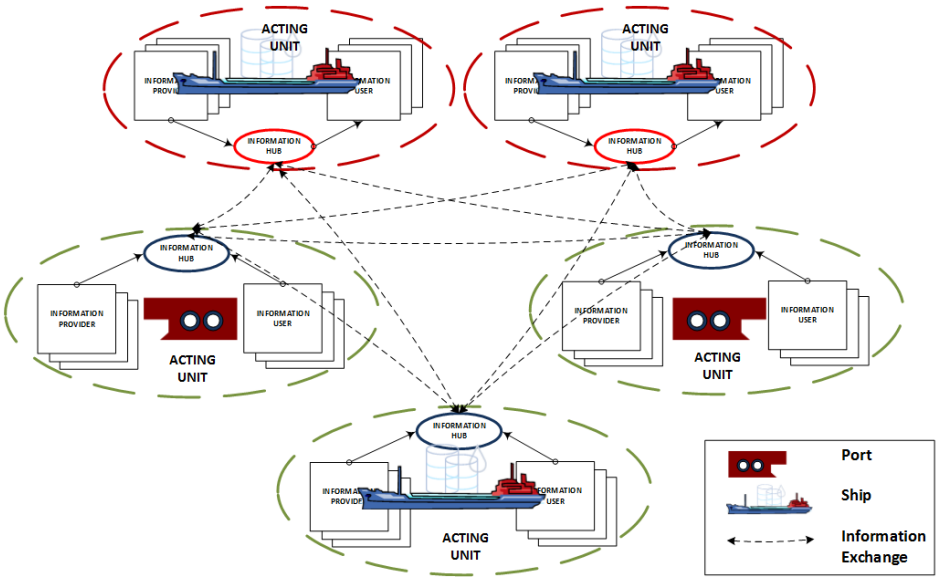


source: own elaboration inspired in MONALISA 2.0 Preliminary Results reports

Various operational (acting) units, i.e. key actors, are engaged in sea transportation, where all operations highly influence the performance of the eco-system as a whole. Each operational unit is to be seen as a "point of interest" collecting several actors acting on behalf of this "point of interest". Examples of "point of interests" related to sea traffic management are ships, ports, authorities and ship-owners. These points of interests involve numerous actors that provide and utilize information to perform their tasks. Optimally each operational unit manages information sharing between different actors by collecting information from information providers (through their sources) and enabling information utilizers to access the information for its operations supported by an information hub. This means that e.g. ships would collect all relevant information from different sources on-board (e.g. the engine, the bridge etc.), refine that, and distribute it to different utilizers on-board the ship as well as to other operational units.

The same applies to the other "points of interest" gathering numerous actors, where the collaborative ability including information sharing is one essential key success factor. Ecosystems where the performance relies on integrated performance of different organizational units requires that information is exchanged between these units efficiently and seamlessly (Figure 7). Applied to Sea Transports examples of units (operationalized in ships and ports) and their needs for information sharing are indicated in figure 6.

Figure 7 - Information exchange in Sea Transports



source: own elaboration inspired in MONALISA 2.0 Preliminary Results reports

Sea Traffic Management (STM) is a concept encompassing all actors, actions, and systems (infrastructure) assisting maritime transport from port to port. STM is a part of the multimodal logistics chain, encompassing sea as well as shore based operations. STM is a network-based approach for optimal Intermodal Sea Transport. STM is performed on multiple actor levels, where each engaged actor co-produces traffic management.

3.3. SAFER SHIP

The newest communication technologies on board ships are being implementing with the aim of improving safety by addressing “soft” (human related) rather than “hard” (equipment related) issues. As a result of current and future availability of broadband satellite communication, ICT is a mature technological enabler for enhanced operational safety from ship side when data sharing is essential.

Methods and tools used in other industrial sectors to promote safe behaviour among the workforce at all levels provide best practice examples that are ready to be transferred/adapted to the maritime environment.

Existing ITS (Intelligent Transport System) solutions, currently used for container tracking, can be tailored to human tracking in an emergency or for rescue purposes.

Under MONALISA 2.0 these technologies are being implementing, testing and demonstrating by means of pilot applications. The Italian Ministry of transport leads this activity and is managing its implementation according to the following topics:

- Behaviour Based Safety (BBS) approach in the maritime sector.

- Pilot application of a new system of chart engines and displays integrated with MONALISA 2.0 in order to share information and search patterns among all participants, including shore units, in the event of a SAR operation.
- NETWORKED VESSEL – pilot application of ICT-based indoor positioning and guidance in an emergency.
- The Safe Evacuation System will evaluate and demonstrate the effectiveness of a system to perform evacuation operations on board passenger ships, and which will be operational in extreme conditions.
- Cost Benefit Analysis.

3.4. OPERATIONAL SAFETY

New technology tools supporting safety in ports and coastal areas is the core of the Operational Safety as key factor for integral safety management, which does not only cover the port landside but also the sea dimension of the port area and the coast. MONALISA 2.0 will contribute to improve the management, coordination and interoperability among the operations and actors involved in crisis, incidents and accidents control in land and at sea.

Focusing on different aspects of operational safety in ports and in coastal waters, the purpose of this activity is to contribute to introduce mature innovations, to improve efficiency in search and rescue (SAR) operations and crisis management, and at the same time, updating the qualifications of personnel involved in SAR, evacuation and in port contingency plans. In this sense, the definition of specific and dedicated training exercises and the deployment of information systems and technologies employed to support SAR, evacuation, first aids and ship recovery is crucial.

MONALISA 2.0 will contribute to improving interoperability among SAR services, passenger ships, VTMIS and Mission Control Centres. Technological innovations include on-board life rafts recovery systems (OLRS), information exchange between land, SAR instruments, ships and other information sources; the dimension of information exchange of real time data is a success factor when the operational safety units must be deployed. Supported by STM infrastructure information exchange, contingency and rescue operations will be improved because of the availability of data, procedures, accidents/incidents case studies, decision support tools and people trained and ready to act.

Another achievement is to provide an instrument for risk analysis to support tactical decisions by means of intelligent tools and decision-making systems. Such instruments will support the analysis of behaviour, reactions and the chain of responsibility during SAR operations. The introduction of novel Safety Information Systems and the improvement of existing ones, making them interoperable, will encompass tests and demonstrations. As a complementary and obliged improving tool in operational safety,

MONALISA 2.0 will also develop dedicated training programmes for the different aspects of maritime safety which will be elaborated and tested with the aim of improving the level of performance of human resources involved in such activities with the novel technology implementation carried out in the project.

Operational safety will contribute to updating the qualifications of personnel involved in SAR, evacuation and port contingency plans, to define specific and dedicated training for the exercises programmed and to define the information systems employed to support SAR, evacuation, first aid and ship recovery systems.

This activity leaded by the Spanish Maritime Safety Agency (SASEMAR) is divided into six sub-activities:

- Safety in ports
  The port plays a crucial role in maritime transport, it is the interface between sea and land. The safety in ports is thought as an instrument to act against risks like fire, pollution of dangerous materials, illegal immigration, terrorism, and people illnesses. At the same time, the port must be ready to assist evacuation from cargo and passenger ships, not only at the port facility but also when Coast Guard and SAR services act at sea level. This is the challenge of safety in ports extending its capacity to deploy its contingency plans and safety procedures to the sea when required.

- Safety in coastal waters
  By means of improved ICT tools, procedures and robust instruments, SAR operations will ensure the minimal loss of lives when an accident happens. In such way, mitigation of maritime pollution will be an aspect to be improved when in-situ information is collected from the accident place and sent to the land decision making instances. Coordination between the units deployed and the MCC will be enhanced under this sub-activity by means of some tests and exercises.

- Risk Assessment
  MONALISA 2.0 will enable field-level risk analysis to support risk management decisions at all levels – ship, port and coast. The objective is to provide support and tactical decisions by means of intelligent tools and decision-making systems at the field level by enabling users to consider the full spectrum of the primary potential risks involved in maritime safety.

- Risk Management Guidelines
  MONALISA 2.0 aims at defining and studying situations of exceptional risk in order to apply an assessment of risky situations management based on past events on board different vessels, the procedures used and results of the procedures implemented and applied.

- Safety information Systems
  This sub-activity will encompass tests and demonstrations of different Safety Information Systems. Such information sources require to include several and different parameters and data, such as Meteorological / Maritime Traffic/ Hydrographical (METEO/MAR/HYDRO) information resources. A common

information exchanging and shared platform will be implemented in order to put together different technologies available and owned by the actors involved in Operational Safety.

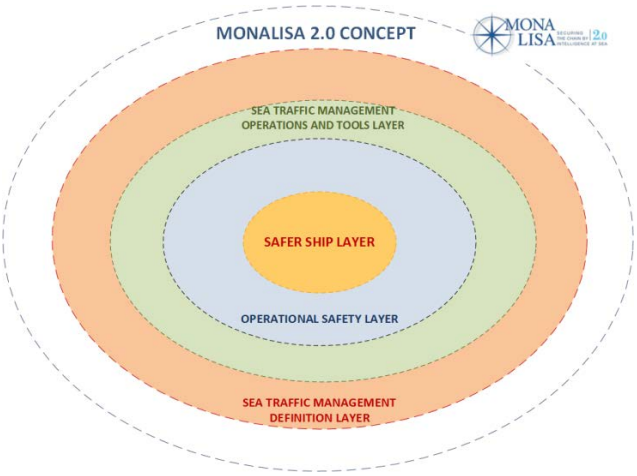
- Training
  The main outcome of ”Training” sub-activity, within the MONALISA 2.0 project is to implement an operational/practical set of training courses covering the subjects proposed for the different fields linked to the operational safety, under the scope of MONALISA concept, towards the proposal for a standardized and certified master course. It is desired that beyond the MONALISA 2.0 project, training activities continue being a suitable tool for the training, useful for the organisms involved and as a part of the training subjects of the educational institutions involved in MONALISA 2.0 project.

4. FOUR ACTIVITIES – ONE AIM: SUSTAINABLE, SAFER, EFFICIENT AND INTEROPERABLE MARITIME TRANSPORT

At first glance, the MONALISA 2.0 project conveys the idea of four separate and unrelated projects, however, the objective of achieving a safer maritime transportation based on the performance of the vessel and its crew, through the tools to ensure their monitoring and verification, passing for their compliance with the planned route and the optimal performance of the crew, to the effectiveness and efficiency in mitigating the impacts of any accidental or unexpected situation, require, under the umbrella the MONALISA concept, a perfect harmonization and coordination between the different actors involved in the transport chain, not only to ensure the integrity of the ship, but also the passengers and the goods transported.

These four elements of development are implemented in such way that the tools for the sea traffic management and their increasingly effective coordinated implementation in Europe, will make the sturdiest vessels in architecture and technology sail with a minimal risk to the crew, passengers and goods, facilitating the tasks to the crew but at the same time, maintaining a level of professionalism that allows them to overcome any issues with clearance, in this sense, a comprehensive professional seafarer may be a key element in the assistance and cooperation with rescue and contingency tools and technologies at his disposal.

Figure 8 - Multilayer Approach of MONALISA 2.0 project



source: own elaboration

In Figure 8 a multilayer approach of MONALISA 2.0 project is presented. At the end of the project, this unified concept will be validated. As it is shown, the ship is in the centre of the scheme as it is the key element for the transport and the object to be monitored, traced, tracked, supervised, assisted and protected. The second layer from the centre, guarantees a constant element for safety in terms of the capacity to act and respond when the ship is under an eventual danger or risky situation. The two external layers will maintain the safety parameters in terms of the information exchange under the concept of Sea Traffic Management. The tools and governance instruments to deploy STM are the crucial factor in MONALISA 2.0 project making Maritime Transport more efficient, safer and sustainable (Figure 9).

Figure 9 - MONALISA 2.0 Project, a Safer, more Efficient and Sustainable Maritime Transport. The Future of Maritime Navigation

source: own elaboration

5. SOME CONCLUSIONS AND EXPERT OPINIONS

MONALISA 2.0 is on the track, preliminary results are on development and they are being published in several international forums. This paper is the first approach to a unified MONALISA concept from the former MONALISA (1) project to the current progress on the second stage of this revolutionary TEN-T (INEA) co-funded project. The support of the European Commission on the extension of our effort is a motivation reason to work together, 10 countries and 39 European Institutions.

After some first dissemination actions we have received some opinions, all these points of view and the ones to come are really important to make our best, taking into account the experience of people who have changed their way to do but not their way to think about the arts on safe navigation. Read below some of these opinions.

5.1. FINN WESSEL, INDEPENDENT MARITIME ADVISER

Mona Lisa 2.0 is air traffic system at sea. Problem arise in narrow waters, where you have small ships and in summer time sailing boats - not under control from the VTS.

5.2. JAN VAN BRUG, CHIEF OFFICER, AND LAST COUPLE OF YEARS AS A CAPTAIN AT PRIMLAKS REEFERS 14 YEARS' EXPERIENCE

I watched the MONALISA videos on the panel showing marvellous routing, and handling ships discharging in ports. I was thinking this is really, marvellous, in future to come? In my mind, I did see the English Channel, it was in the paper, "The Telegraph today", and they worried about the increasing traffic of ships passing the appointed lanes, well known by many of you. Harbours entrances, like Bayonne in Biscay, only 6 meter waves caused the Luna to break in two; electrical failures, no more steering, no more propulsion. I did enter that harbour more than once also during a severe gale westerly destination, Oporto Portugal. Advice from the harbour authorities: "captain drop your anchor", first I did look on my well updated Map. My surprise how can we reach the bottom here. That was impossible, I informed them about my decision to keep the ship going during the storm and ride it out. After 2 days we could enter, one of my college Captains did drop his anchor closer to the shore. They entered before us. After we were well alongside our berth I did visit my friend, over there, Anchor winch was severely damaged all his dunnage wood was swept from the deck by a huge wave when he entered, these differences always will be there calmness, experience careful and keep trust in something, especially yourself.

5.3. ANDREW DONALD AFNI, BUSINESS DEVELOPMENT MANAGER - MARITIME SECTOR AT IN-SITU PACIFIC LIMITED

Parallels are often drawn between Sea Traffic Management and Air Traffic Management systems, procedures and technologies. Having had well over thirty years' experience in dealing with Air Traffic and Vessel Traffic systems design, development

and implementation around the world, I certainly see the many advantages that could accrue to the Maritime World by adopting large slices of the Aviation experience.

However it seems that the complex issues surrounding:

1. Legislation - national and international;
2. States/Sovereign rights - Ships' Flag States, Flags of convenience etc., and
3. Hundreds of years of Maritime Tradition - e.g. "Master in Command"

are not yet being publicly addressed and debated.

The single biggest advantage that the Air Traffic System has over the Vessel Traffic System is that the State, the Captain of the Aircraft and the Aircraft Operating Company are all Part of the System. And all of these actors are subject to, and must abide by, strict, internationally adopted, operating controls and procedures. (ICAO, Eurocontrol, National AIP and so on). The bottom line is, in Air Traffic Systems, the Pilots' response to Air Traffic Control is a given.

I think that the maritime world has a long way to go yet in terms of overcoming tradition, States Rights and so on, before the true benefits of a MONALISA type approach can be enjoyed. For example AIS is "compulsory", but how many times is ship borne AIS seen to be poorly installed, not updated or in some cases, even switched off. In an Aircraft, the Captain will never switch off ADS (B), and ADS (B) installations in all RPT aircraft are certified.

IMO and IALA need to significantly speed up the regulatory frame work for e-Nav and catch up to the existing, and more importantly, emerging technology so that the true benefits can be enjoyed by all. MONALISA is a great approach but the more difficult "soft" issues surrounding implementation must also be addressed and addressed quickly.

5.4. REX MAY, PRODUCT AUDIT MANAGER AT UKHO

I agree with much of your comment above, but in my view we need to look into the fundamentals to discover whether centralised traffic control is possible (or desirable) for maritime traffic.

Putting the Master in charge is not just a romantic tradition; it is a necessity, since the shore-side traffic controllers do not have the full information about other vessels, small semi-submerged objects (such as twenty foot containers), ice-bergs, lobster pot floats, the sea state and the status of the machinery onboard the ship in order to make sensible navigational decisions.

Air traffic control also have the great benefit of being able to effect vertical separation between aircraft to make collision avoidance easier; this is not possible for ships which all float on the same surface.

In my view control of ships by shore controllers is only practicable in ports and approaches etc. where it is already exercised.

5.5. CAPT. NISHANT DHIR, LEAD CONSULTANT HSEQ/TRAINING/PROJECTS AT TRIADIC CONCEPTS AND SOLUTIONS

Rex and Andrew make very valid points. As an industry we have to evolve and adopt new technology. However we cannot just adopt every aspect Air Traffic Management.

One of the biggest differences in sea and air traffic management is that each and every vessel does not become part of a VTS system. A lot of small craft and pleasure crafts do not, become part of the system. Many small barges and small craft, not to mention pleasure craft, do not participate in VTS services. This will be one of the biggest challenges for an integrated traffic management system.

Also another issue that may arise is what kind of human attention will be required to man the interactive system. Will it require a dedicated officer, or how much of the time of the navigational officer will be required by it. Will it distract him from other watch keeping duties?

5.6. ULF SIWE, COMMUNICATION OFFICER AT SJÖFARTSVERKET, MONALISA 2.0 PROJECT

Many valid points from Rex, Andrew and Nishant. I believe Sea Traffic Management should not copy Air Traffic Management, but good ideas and concepts should be stolen and adapted to maritime conditions. That is why the MONALISA projects do NOT introduce Traffic Control. I believe that the Master is the right person to be in charge. If we can improve his tools regarding situational awareness and assist him with relevant information in a manner which takes less time away from navigation, it is a step towards safer.

Both Air and Sea are struggling with the information flow from vessel to (air) port in order to make the (air) port call as efficient as possible. This is another area where Sea traffic should be inspired by, AND inspire, the Air.

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[8] The national standards should be in conformity with the prescriptions of the International Hydrographic Organisation (IHO) where a state is a member of the IHO.